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EFFECT OF SULPHUR AND ZINC ON CONTENT AND UPTAKE OF NUTRIENTS OF SUMMER GREEN GRAM (*VIGNA RADIATA* L.WILEZECK) UNDER MEDIUM BLACK CALCAREOUS SOILS

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ABSTRACT

A field experiment was conducted during the summer season of 2014, at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh to assess the response of summer green gram (Vigna radiata L. Wilezeck) to four levels of sulphur viz., 0, 10, 20 and 30 kg S ha^{-1}, and three levels of Zinc viz., 0, 2.5 and 5.0 kg Zn ha^{-1}. The results of different sulphur and zinc levels depicted that application of 30 kg S ha^{-1} and 5.0 kg Zn ha^{-1} significantly higher in N, P, K, S and Zn content and uptake by seed and straw. Interaction of sulphur and zinc gave significant results.

KEYWORDS: Summer Green Gram, Sulphur Levels, Zinc Levels, Nutrients Content & Uptake & Avaialble Nutrients Status

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Original Article

INTRODUCTION

Mung bean (*Vigna radiata* L. Wilezeck) has been grown in India, since ancient times. It is also referred to as green gram, golden gram and chop suey bean. Mung bean is grown widely for use as a human food (as dry beans or fresh sprouts), but can be used as a green manure crop and as forage for livestock. The Saurashtra region of Gujarat is being highly influenced by the vagaries of monsoon, which results in low and unstable crop yields. The region faces twin problems of poor fertility and inadequate moisture availability for crop production.

Sulphur, an essential secondary plant nutrient, is required by plant and animals in approximately the same amount as phosphorus. On an average, the amount of sulphur content in the earth crust is ranged about 0.06 to 0.10 per cent. Pulses are particularly responsive to sulphur containing fertilizers, and that elementary sulphur or sulphates increases the percentage of nitrogen as well as yield on such deficient soils.

Micronutrient malnutrition, particularly of Zn, is presently at an alarming proportion in many developing nations (Hortz and Brown, 2004). Spraying micronutrient is beneficial for the growth of green grams and its quality (Khorgami and Farnia, 2006). Zinc deficiency is a major problem, not only because of the direct effect of low Zn levels, but also because it contributes to susceptibility and progression in other diseases, especially infectious diseases in childhood (Maret and Standstead, 2006). At the same time, the management of sulphur and zinc is must to achieve potential green gram production.

MATERIAL AND METHODS

The experiment was conducted during *Rabi*, season 2013-14 in D-5 plot of Instructional Farm at Krushigadh, College of Agriculture, Junagadh Agricultural University, Junagadh. The experiments were laid out in Factorial Randomized Block Design having 12 treatments with three replications. The experiment consisted of 4 levels of sulphur (0, 10, 20 and 30 kg S ha^{-1}) and 3 levels of zinc (0, 2.5, 5 kg S ha^{-1}).

The soil of the experimental field was medium black calcareous soil with pH 8.0 and EC 0.57 dS m^{-1}. The crop was fertilized with sulphur and zinc, as per treatment allotted to each plot in the form of Cosavet fertis, WG (90%) and ZnO in basal application. Green gram, GM- 4 variety was used as planting material in this study. The seeds were dibbled at a spacing of 30×10 cm, using a seed rate of 20 kg ha^{-1} during the first week of February.

Five plants were selected at random from each plot to record individual plant nutrient content and uptake by some analyses in the leaves, shoot, root and seed. The soil analysis was carried out according to standard methods. The soil used in the experiment was clayey in texture, containing 35.16, 2.97 and 61.87% sand, silt and clay, respectively. The pH, EC (25°C) and available N, P, K, S and Zn were 8.0, 0.57 dS m^{-1} and 207.30 kg ha^{-1}, 36.80 kg ha^{-1}, 185.70 kg ha^{-1}, 14.38 kg ha^{-1} and 0.77 kg ha^{-1} respectively. In general, the experimental soil was medium in N as well as K and low in P and S.

RESULTS AND DISCUSSIONS

Effect of Sulphur

Application of 30 kg S ha^{-1} (S_3) significantly resulted in higher N content in seed (3.73 %) & straw (0.85 %), P content in seed (0.368 %) & straw (0.182 %), K content in seed (0.766%) & straw (1.642 %), S content in seed (0.168 %) & straw (0.107 %) and Zn content in seed (100.40 ppm) & straw (15.37 ppm), respectively,

The highest N uptake by seed (40.56 kg ha^{-1}) & straw (16.44 kg ha^{-1}), P uptake by seed (4.0 kg ha^{-1}) & straw (3.52 kg ha^{-1}), K uptake by seed (8.32kg ha^{-1}) & straw (31.76 kg ha^{-1}), uptake of S by seed (1.830 kg ha^{-1}) & straw (2.077 kg ha^{-1}) and Zn uptake by seed (110.25 g ha^{-1}) & straw (29.80 g ha^{-1}), recoded under 30 kg S ha^{-1} was significantly superior to the control (S_0),

It might be due to the fact that sulfur application improves over all nutritional environment of the *Rhizosphere*, which favors the uptake of nutrients by plant root. Similar results were noticed by Tripathi *et al*. (1997) for content and uptake of zinc by chickpea, Wasmatkar *et al.* (2002) for N, P, K and S uptake and Sangale and Sonar (2004) for N and S uptake in soybean and Bansal *et al.* (1985) for N, P, K and S content in legumes like soybean, green gram, black gram and cowpea with the application of sulphur.

Effect of Zinc

Different levels of zinc failed to produce significant effect on N and K content in green gram seed, it had significantly the highest N content in straw (0.81 %), P content in straw (0.168%), K content in straw (1.551 %), S content in seed (0.143 %) and straw (0.094%) and Zn content in seed (97.42 ppm) and straw (15.84 ppm) was noticed with the application of zinc @ 5.0 kg Zn ha^{-1} (Zn_2)

Increasing levels of zinc produces significant effect. Significantly, the highest N uptake by seed (36.97 kg ha^{-1}) and straw (15.59 kg ha^{-1}), P uptake by seed (3.65 kg ha^{-1}) and straw (3.23 kg ha^{-1}), K uptake by seed (6.93kg ha^{-1}) and straw (29.72kg ha^{-1}), S uptake by seed (1.483 kg ha^{-1}) and straw (1.807 kg ha^{-1}), Zn uptake by seed (101.13 g ha^{-1}) and

straw (30.31 g ha^{-1}) registered under application of zinc @ 5.0 kg ha^{-1}.

Zinc is known for utilization of macro-nutrients like N and P, which might increase the content and uptake of nutrients viz., N, P, K, S and Zn by the crop. Similar results were also noticed by Tayyeba *et al.* (2013) in green gram, Azad *et al.* (1993) in lentil and Khorgamy and Farnia (2006) in chickpea.

Interaction Effect

The S x Zn interaction was found significant effect. Treatment combination of 30 kg S and 5.0 kg Zn ha^{-1} (S_3Zn_2) recorded significantly higher S content in seed (0.173%) and straw (0.120 %) and Zn content in seed (117.13 ppm) and straw (16.06 ppm), P uptake by straw (3.87 kg ha^{-1}), K uptake by straw (34.75 kg ha^{-1}), S uptake by seed (2.00 kg ha^{-1}) and straw (2.48 kg ha^{-1}) & Zn uptake by seed. The increasing levels of both the factors generally recorded higher protein content indicating the synergistic effect of one on another.

CONCLUSIONS

It might be due to sulphur and zinc that play a vital role in activation of enzymes and in carbohydrate metabolism, which improves the nutrients' uptake. Similar results were noticed by Srivastav *et al.* (2006), who observed in summer green gram, and Chauhan (2013) and Singh and Singh (1995) in soybean.

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APPENDICES

Table 1: Effect of Sulphur and Zinc on Content of N, P, K, S and Zn by Seed and Straw

Treatments	N Content (%)		P Content (%)		K Content (%)		S Content (%)		Zn Content (%)	
	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw
Levels of Sulphur (Kg Ha^{-1})										
S_0: 00	3.45	0.74	0.328	0.153	0.589	1.382	0.119	0.076	79.20	14.71
S_1: 10	3.48	0.76	0.362	0.156	0.614	1.509	0.125	0.080	82.25	15.02
S_2: 20	3.63	0.81	0.366	0.165	0.681	1.548	0.153	0.090	85.89	15.07
S_3: 30	3.73	0.85	0.368	0.182	0.766	1.642	0.168	0.107	100.40	15.37
S. Em. ±	0.05	0.01	0.009	0.001	0.009	0.016	0.001	0.001	2.45	0.11
CD (P = 0.05)	0.15	0.04	0.025	0.003	0.026	0.048	0.003	0.004	7.17	0.32
Levels of Zinc (kg ha^{-1})										
Zn_0: 0	3.54	0.79	0.348	0.161	0.653	1.488	0.139	0.083	75.97	14.17
Zn_1: 2.5	3.58	0.77	0.365	0.163	0.664	1.521	0.141	0.088	87.40	15.12
Zn_2: 5.0	3.60	0.81	0.355	0.168	0.671	1.551	0.143	0.094	97.42	15.84
S. Em. ±	0.04	0.01	0.007	0.001	0.008	0.014	0.001	0.001	2.12	0.10
CD (P = 0.05)	NS	0.03	NS	0.003	NS	0.041	0.003	0.004	6.21	0.28
S × Zn Interaction	NS	NS	NS	NS	NS	NS	Sig.	Sig.	Sig.	Sig.
CV %	4.25	4.84	7.28	2.14	4.00	3.21	2.18	4.98	8.44	2.19

Table 2: Effect of Sulphur and Zinc on Uptake of N, P, K, S and Zn by Seed and Straw

Treatments	N Uptake (Kg Ha^{-1})		P Uptake (Kg Ha^{-1})		K Uptake (Kg Ha^{-1})		S Uptake (Kg Ha^{-1})		Zn Uptake (Kg Ha^{-1})	
	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw
Levels of Sulphur (Kg Ha^{-1})										
S_0: 00	30.88	12.36	2.93	2.55	5.28	23.15	1.063	1.272	71.39	24.74
S_1: 10	32.44	13.40	3.37	2.76	5.74	26.69	1.165	1.425	78.43	26.62
S_2: 20	35.02	15.41	3.53	3.13	6.57	29.28	1.471	1.703	82.97	28.55
S_3: 30	40.56	16.44	4.00	3.52	8.32	31.76	1.830	2.077	110.25	29.80
S. Em. ±	0.94	0.31	0.13	0.05	0.19	0.36	0.032	0.044	4.33	0.55
CD (P = 0.05)	2.76	0.91	0.38	0.14	0.56	1.07	0.093	0.128	12.71	1.61
Levels of Zinc (kg ha^{-1})										
Zn_0: 0	32.25	13.50	3.17	2.76	5.98	25.57	1.276	1.437	69.92	24.30
Zn_1: 2.5	34.94	14.12	3.56	2.98	6.52	27.87	1.389	1.613	86.23	27.68
Zn_2: 5.0	36.97	15.59	3.65	3.23	6.93	29.72	1.483	1.807	101.13	30.31
S. Em. ±	0.81	0.27	0.11	0.04	0.16	0.31	0.027	0.038	3.75	0.47
CD (P = 0.05)	2.39	0.79	0.33	0.12	0.48	0.92	0.081	0.111	11.01	1.39
S × Zn Interaction	NS	NS	NS	Sig	NS	Sig.	Sig.	Sig.	Sig.	NS
CV %	8.12	6.50	11.37	4.85	8.81	3.93	6.87	8.09	15.16	5.99

Table 3: Interaction Effect of S and Zn on S & Zn Content in Seed and Straw

Level of Zinc	Level Of Sulphur															
	Seed								Straw							
	S Content (%)				Zn Content (Ppm)				S Content (%)				Zn Content (Ppm)			
	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3
Zn_0	0.116	0.126	0.151	0.164	74.50	66.14	81.22	82.01	0.074	0.078	0.087	0.096	13.72	14.10	14.42	14.43
Zn_1	0.120	0.127	0.149	0.169	80.01	82.90	84.67	102.03	0.076	0.081	0.090	0.104	14.50	15.40	14.97	15.62
Zn_2	0.122	0.124	0.158	0.173	83.08	97.69	91.78	117.13	0.079	0.084	0.094	0.120	15.92	15.55	15.83	16.06
S. Em. ±	0.001				4.23				0.001				0.19			
CD (P = 0.05)	0.003				12.48				0.003				0.56			
C.V. %	2.48				8.44				4.98				2.19			

Table 4: Interaction Effect of S and Zn on S & Zn Uptake by Seed and P, K & S Uptake by Straw

Level of Zinc	Level of Sulphur																			
	Seed								Straw											
	S Uptake (kg ha^{-1})				Zn Uptake (kg ha^{-1})				P Uptake (kg ha^{-1})				K Uptake (kg ha^{-1})				S Uptake (kg ha^{-1})			
	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3	S_0	S_1	S_2	S_3
Zn_0	1.06	1.00	1.41	1.63	68.91	53.03	75.89	81.85	2.26	2.67	2.95	3.16	19.91	25.73	27.88	28.78	1.10	1.35	1.58	1.71
Zn_1	1.08	1.21	1.42	1.85	72.92	78.59	80.85	112.59	2.65	2.77	2.99	3.52	24.21	26.86	28.64	31.76	1.32	1.44	1.66	2.04
Zn_2	1.05	1.29	1.58	2.00	72.35	103.69	92.18	136.32	2.75	2.85	3.44	3.87	25.33	27.50	31.32	34.75	1.39	1.49	1.87	2.48
S. Em. ±	0.05				7.75				0.08				0.63				0.08			
CD (P = 0.05)	0.16				22.01				0.25				1.85				0.22			
C.V. %	6.88				15.16				4.85				3.93				8.10			

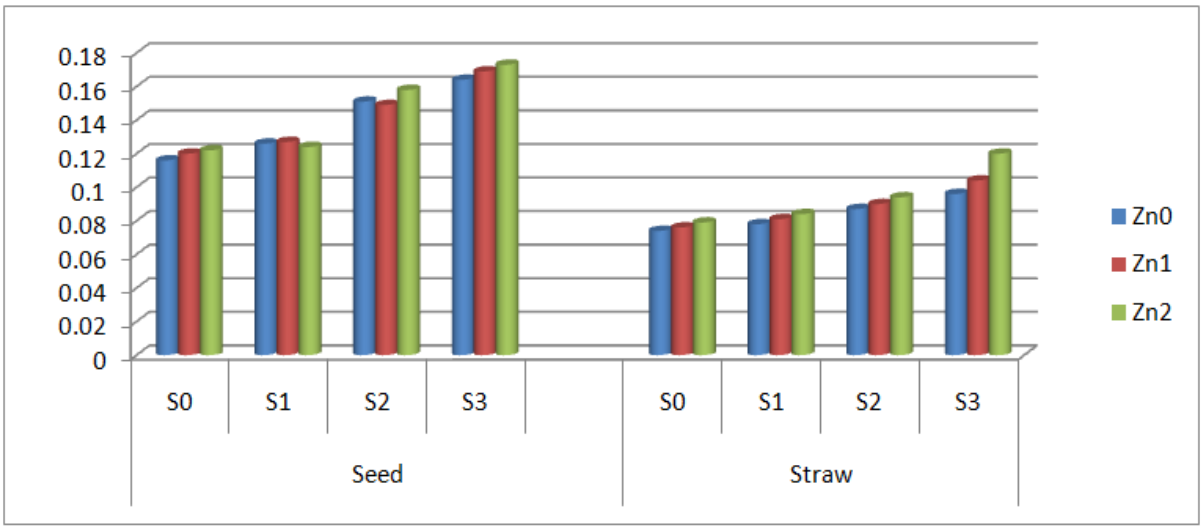

Figure 1: Interaction Effect of S and Zn on S Content in Seed and Straw

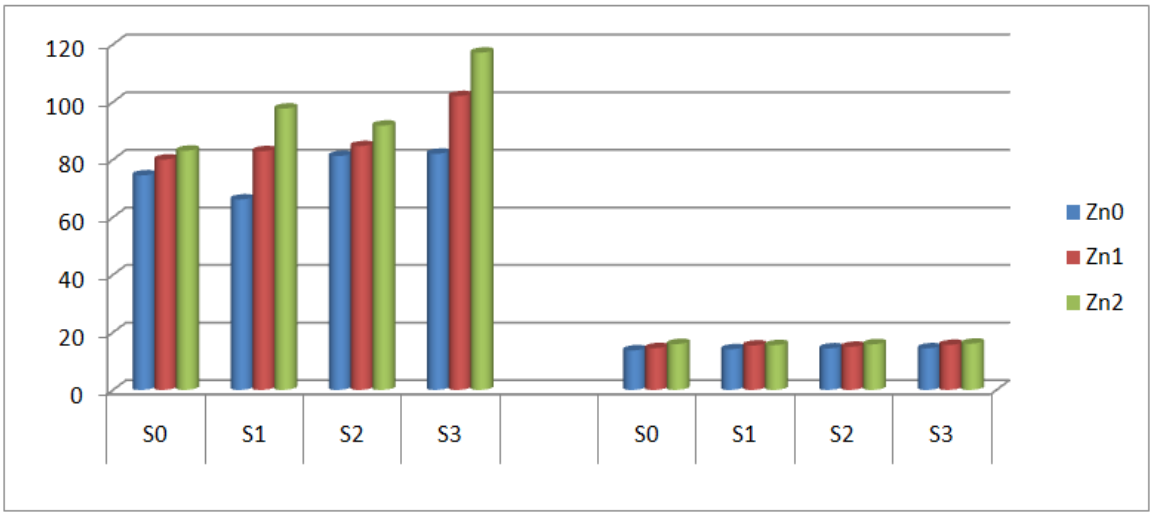

Figure 2: Interaction Effect of S and Zn on Zn Content in Seed and Straw